Introduction to AGWA
The Automated Geospatial Watershed Assessment Tool

Preparing AGWA Input GIS Layers for BAER Scenarios

Introduction:	In this exercise you will alter downloaded GIS layers to prepare them for use in AGWA
Goal:	To familiarize yourself with the data management processes required to use AGWA in a BAER scenario
Assignment:	Project, clip, and perform other necessary processes to GIS layers. These layers include a DEM, land cover, and soils.

A Short Introduction to GIS Data Management for AGWA

The AGWA tool is designed to provide a user-friendly GIS-interface to run two models: the Soil & Water Assessment Tool (SWAT), and the Kinematic Runoff and Erosion model (KINEROS2). This is very useful for watershed-scale modeling, where the routing capabilities of these models can be utilized along with spatial input data provided by GIS layers. At a minimum, AGWA requires three GIS layers to help derive all the necessary input parameters for SWAT and KINEROS:

- Digital Elevation Model (DEM): this layer is used by AGWA in determining watershed boundaries and other model-specific parameters. DEMs are publically available from multiple sources including the United States Geological Survey's (USGS) National Map (available at nationalmap.gov)[1].
- Land Cover: an integer raster dataset representing the distribution of landscape classes across a study area. Several datasets are supported by AGWA natively, including National Land Cover Dataset (NLCD), and National Gap Analysis (GAP) land covers. Additionally, users may use custom datasets if an associated land cover look-up table exists. NLCD data is also available from the National Map.
- Soils: a polygon shapefile or feature class representing the soil types across the study area. Supported classifications include STATSGO, SSURGO, and FAO. STATSGO and SSURGO data are available from the Web Soil Survey (available at websoilsurvey.sc.egov.usda.gov) [1]

In a BAER rapid assessment situation, these layers may have to be gathered and prepared for AGWA modeling quickly. It is best therefore, to do as much data preparation as possible in advance.

The Study Area

The Mountain Fire began on July 15, 2013 on private land in Riverside County, CA, and burned a total of 27,531 acres before being declared contained on July 30 (Figure 1). Over 50% of the burned area was within the San Bernardino National Forest, while approximately 30% was within land under the jurisdiction of the Department of the Interior (DOI). The burned DOI lands included 2,443 acres of

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Bureau of Land Management lands, and 5,783 acres of Bureau of Indian Affairs, the Agua Caliente Band of Cahuilla Indians (ACBCI) lands. A national DOI BAER team was assigned to assess the DOI lands.
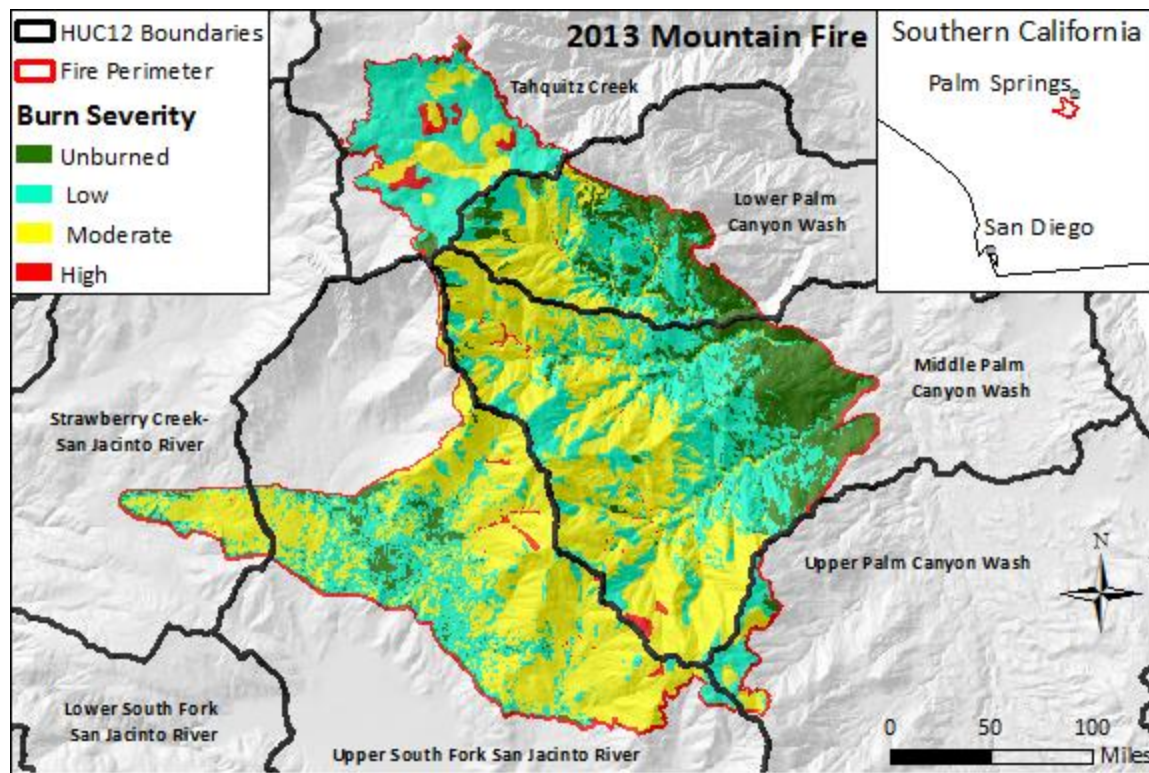

Figure 1. The burn severity map of the Mountain Fire with affected 12-digit hydrological unit codes (HUC 12).

This exercise goes through the necessary data management steps to prepare downloaded GIS data for use in AGWA modeling. The data prepared in this tutorial will be used for the next tutorial, the Mountain Fire tutorial.

Getting Started

The first step in any AGWA project is to obtain the necessary input data. In a BAER scenario, this involves downloading data from the national data repository websites listed above, obtaining data from local agency GIS specialists, and obtaining data from fire suppression personnel. This exercise assumes all the necessary data has been previously obtained, and is located within the *C:\Downloads* folder.

Open ArcCatalog. Folder connections to drives and folders where your data is stored must be established if they are not already. To establish new folder connections, click the **Connect To Folder** button 🗁 on the menu bar at the top of the screen. Select **OS (C:)**.

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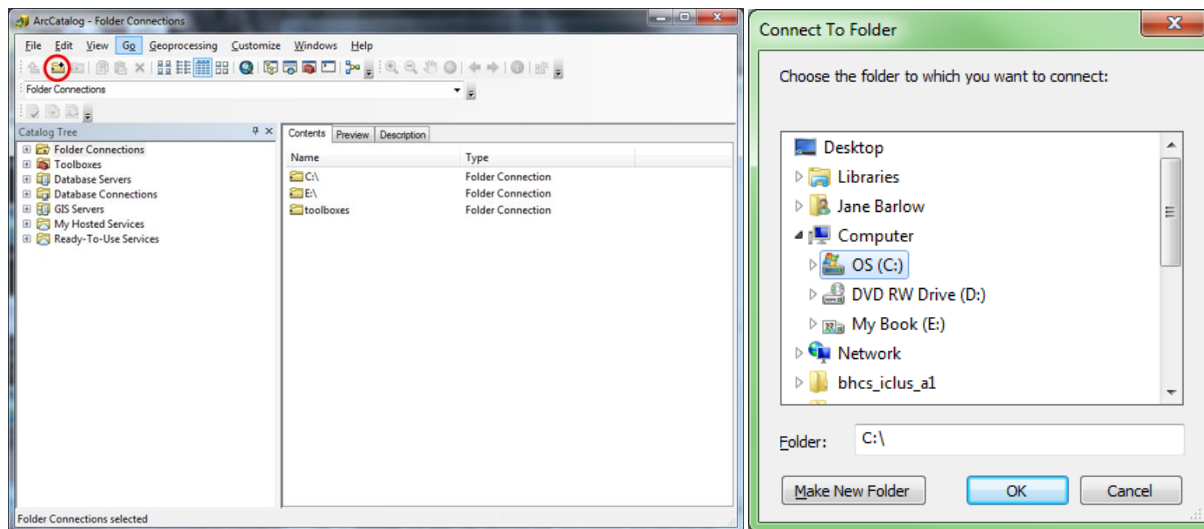
Once the folder connection is established, navigate to the **C:\Downloads** folder. The following folder, datasets, and layers should be present:

- **..\wss_gsmsoil_CA_[2006-07-06]** folder (contains the soils layer)
- **..\10mdem** (10 meter DEM)
- **..\fire_perim** (perimeter of Mountain Fire)
- **..\HUC12.shp** (HUC 12s for southern California)
- **..\Mountain_Final_SBS.shp** (Mountain Fire burn severity map)
- **..\NLCD2006.tif (**NLCD 2006 for southern California)
- **..\VARs** (Values at risk)

Copy the data, and paste it in the **C: \AGWA\gisdata\tutorial_MountainFire** folder. You may need to create both the *gisdata* and *tutorial_MountainFire* folders. Close ArcCatalog when the data have successfully copied to the new location.
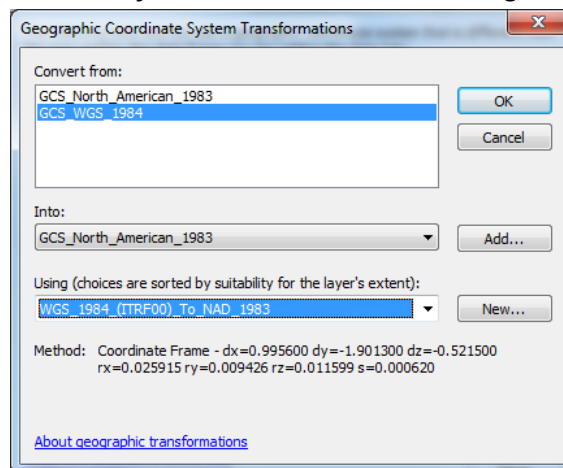
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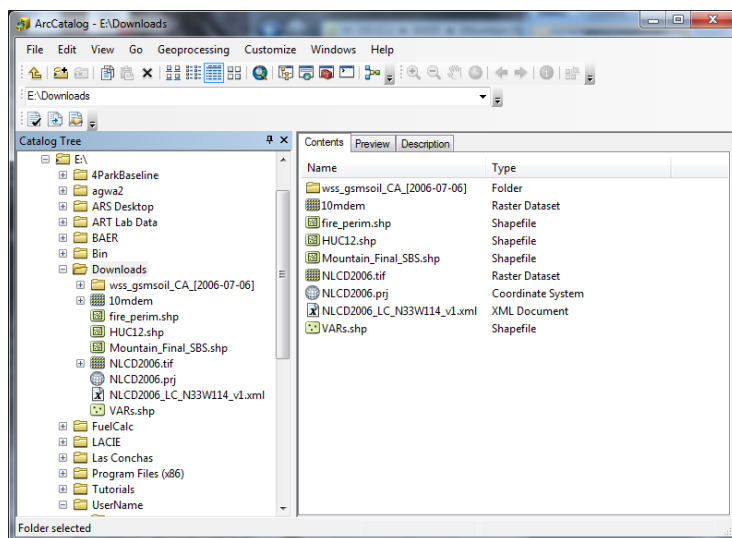
Part 1: Projecting Data into a Common Coordinate System

Step 1: View the data in ArcMap

1. Start ArcMap with a new empty map.
   1.1. Save the empty map document as **tutorial_DataManagement** in the **C:\AGWA\gisdata\tutorial_MountainFire** folder.
   1.2. Click on the ***Add Data*** button ⊕⋅ below the menu bar at the top of the screen, and navigate to **C:\AGWA\gisdata\tutorial_MountainFire**. You may need to establish a folder connection as done in ArcCatalog.
      1.2.1. Select all the layers (click and drag or hold the shift key) except for the ***wss_gsmsoil_CA_[2006-07-06]*** folder.
      1.2.2. Click ***Add***.
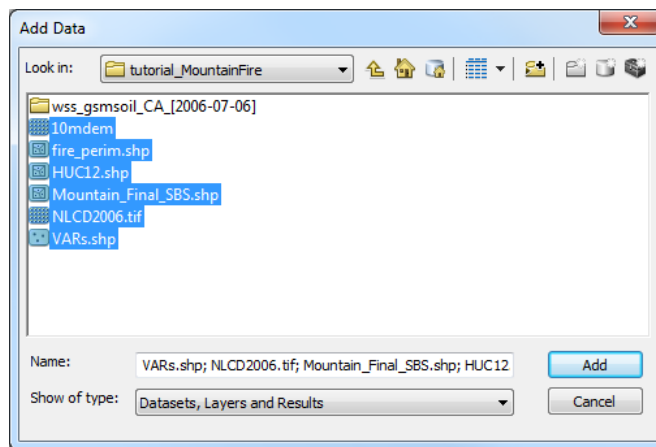
   1.3. Click the Add Data button again.
      1.3.1. This time, open the **wss_gsmsoil_CA_[2006-07-06]** folder, and navigate to **spatial > gsmsoilmu_a_ca.shp**.
      1.3.2. Click ***Add***. A ***Geographic Coordinate Systems Warning*** window appears.
         1.3.2.1. Click ***Transformations***. Make the following selections:

            1.3.2.1.1. ***Convert from***: **GCS_WGS_1984**
            1.3.2.1.2. ***Into***: **GCS_North_American_1983**

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1.3.2.1.3. *Using:* **WGS_1984_(ITRF00)_To_NAD_1983**

    1.3.2.2. Click *OK* to exit the *Geographic Coordinate System Transformations* window.

  1.3.3. Click *Close* to exit the *Geographic Coordinate Systems Warning* window.

Take a look at the data you have available to you to familiarize yourself with the area. Layers can be reordered, turned on/off, and their legends collapsed to suit your preferences and clean up the display.

If you the layers cannot be reordered by clicking and dragging, the *List By Drawing Order* - button may need to be selected at the top of the *Table Of Contents*. Place the *gsmsoilmu_a_ca* layer below the other layers, and zoom to the *HUC12* layer.

Step 2: Project the Data to a Common Data Frame

Projecting data into a common data frame is a necessary step to use the data in AGWA, and is a generally sound practice for any sort of GIS analysis.
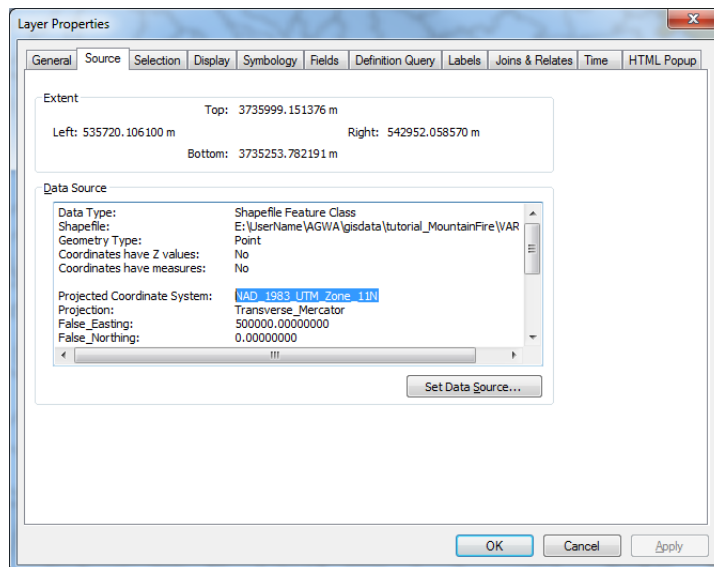
2. View the current projections of the layers.

  2.1. Double click on the *VARs* layer in the *Table of Contents*.

    2.1.1. In the *Source* tab:

      2.1.1.1. Notice the Projected Coordinate System, which is *NAD_1983_UTM_11N*. Since this coordinate system covers all of southern California, it is a suitable projection to use for all the layers.

        Click OK.

 2.2. Double-click on the *HUC12* layer in the *Table of Contents*.

    2.2.1. In the *Source* tab:

      2.2.1.1. Notice this layer is in the geographic coordinate system *GCS_North_American_1983*. This must be reprojected.

      2.2.1.2. Click *OK*.

  2.3. View the current coordinate systems of the other layers and note which ones are not in *NAD_1983_UTM_11N* and will need to be reprojected.

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3. Reproject the noted layers to the ***NAD_1983_UTM_11N*** coordinate system.
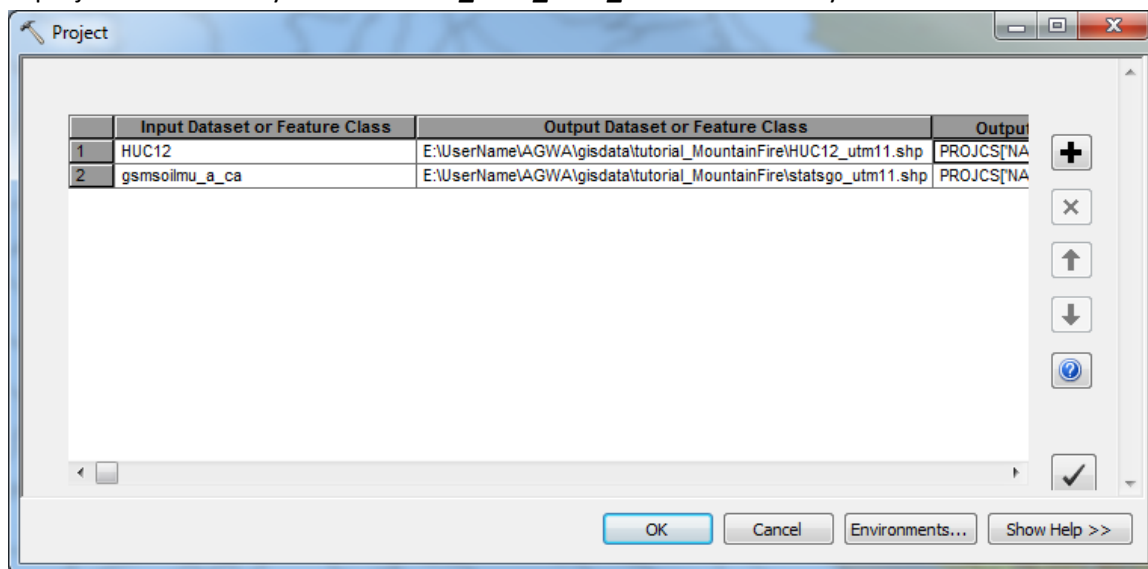
3.1. Open ArcToolbox using the ArcToolbox button ![icon] in the Standard Toolbar in ArcMap.

    3.1.1. Navigate to ***Data Management Tools > Projections and Transformations***.

    3.1.2. Right-click on the ***Project*** tool, and select ***Batch***.

        3.1.2.1. ***Input Dataset or Feature Class***: double-click and select **HUC12**.

        3.1.2.2. ***Output Dataset or Feature Class***: right-click, select ***Browse***.

            3.1.2.2.1. Navigate to the folder **C:\AGWA\gisdata\tutorial_MountainFire**.

            3.1.2.2.2. Name the file **HUC12_utm11**.

        3.1.2.3. ***Output Coordinate System***: double-click and select the Spatial Reference Properties button ![icon] .

            3.1.2.3.1. Expand the ***Layers*** folder, and select **NAD_1983_UTM_Zone_11N**.

        3.1.2.4. ***Geographic Transformation***: leave blank.

        3.1.2.5. ***Input Coordinate System***: do nothing.

    3.1.3. Click the Add row button ![icon] . Fill out the second row.

        3.1.3.1. ***Input Dataset or Feature Class***: double-click and select **gsmsoilmu_a_ca**.

        3.1.3.2. ***Output Dataset or Feature Class***: right-click, select ***Browse***.

            3.1.3.2.1. Navigate to the folder **C:\AGWA\gisdata\tutorial_MountainFire**.

            3.1.3.2.2. Name the file **statsgo_utm11**.

        3.1.3.3. ***Output Coordinate System***: double-click and select the Spatial Reference Properties button ![icon] .

            3.1.3.3.1. Expand the ***Layers*** folder, and select **NAD_1983_UTM_Zone_11N**.

            3.1.3.3.2. ***Geographic Transformation***: leave at its pre-populated value- ***WGS_1984_(ITRF00)_To_NAD_1983***.

            3.1.3.3.3. ***Input Coordinate System***: do nothing.

    3.1.4. Click ***OK***. Wait for the ***Project*** tool to run, which will create two new shapefiles.

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3.2. Return to ArcToolbox. Now reproject the raster layers.
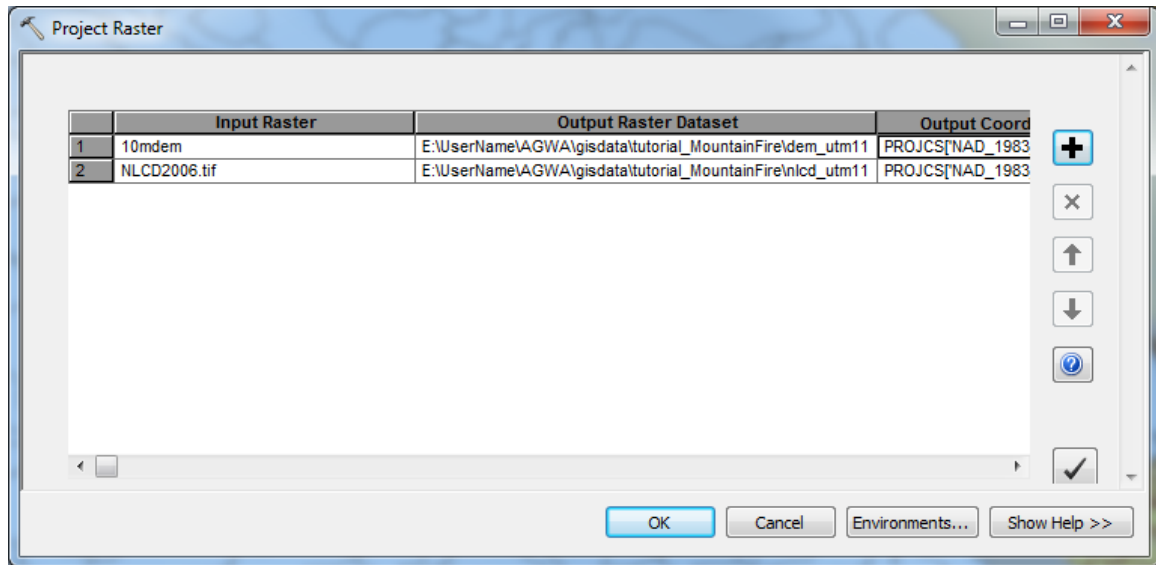
3.2.1. Navigate to *Data Management Tools > Projections and Transformations > Raster*.

3.2.2. Right-click on the *Project Raster* tool, and select *Batch*.

    3.2.2.1. *Input Raster*: double-click and select **10mdem**.

    3.2.2.2. *Output Raster Dataset*: right-click and select *Browse*.

        3.2.2.2.1. Navigate to the folder **C:\AGWA\gisdata\tutorial_MountainFire**

        3.2.2.2.2. Name the file **dem_utm11**

    3.2.2.3. *Output Coordinate System*: double-click and select the Spatial Reference Properties button.

        3.2.2.3.1. Expand the *Layers* folder, and select **NAD_1983_UTM_Zone_11N**.

    3.2.2.4. *Resampling Technique*: click the drop-down arrow and select **Bilinear**.

    3.2.2.5. Do not alter any of the other columns.

3.2.3. Click the Add row button ✚. Fill out the second row.

    3.2.3.1. *Input Raster*: double-click and select **NLCD2006.tif**

    3.2.3.2. *Output Raster Dataset*: right-click, select *Browse*.

        3.2.3.2.1. Navigate to the folder **C:\AGWA\gisdata\tutorial_MountainFire**.

        3.2.3.2.2. Name the file **nlcd_utm11**.

    3.2.3.3. *Output Coordinate System*: double-click and select the Spatial Reference Properties button.

        3.2.3.3.1. Expand the *Layers* folder, and select **NAD_1983_UTM_Zone_11N**.

        3.2.3.3.2. *Resampling Technique*: leave at the default - **Nearest**.

    3.2.3.4. Do not alter any of the other columns.

3.2.4. Click *OK*. Wait for the *Project* tool to run, which will create two new rasters.

4. Ensure that the data frame is also in the correct projection.

4.1. In the *Table of Contents*, right-click on the data frame *Layers* and select *Properties* from the context menu.

    4.1.1. In the *Coordinate System* tab:

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4.1.1.1. Scroll to the *Layers* tab, expand, and select **NAD_1983_UTM_Zone_11N**.

4.1.1.2. Click the *Transformations* button and make the following selections:

4.1.1.2.1. *Convert from*: **GCS_WGS_1984**

4.1.1.2.2. *Into*: **GCS_North_American_1983**

4.1.1.2.3. *Using:* **WGS_1984_(ITRF00)_To_NAD_1983**
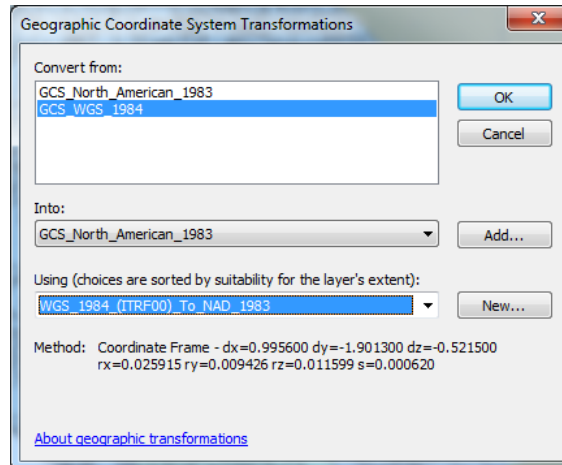
4.1.1.3. Click *OK* to exit the *Geographic Coordinate System Transformations* window.

4.1.2. Click *Apply*.

4.1.3. Click *OK*.

Part 2: Clip the Data to a Suitable Project Area

In Part 2, the reprojected data will be clipped to a project area. Depending on the original datasets' sizes and the clipped areas of interest, this may significantly reduce processing time during AGWA steps involving raster data. In this exercise, the DEM, Land Cover layer, and soils layer are all regional in scale at this point, and should be clipped.

### Step 1: Create a Suitable Project Area Shapefile

Deciding on a suitable clip size is not always easy. In a BEAR scenario, one might want to choose the fire perimeter as the project area. However, watersheds do not conform to the burn area, so a wider project area is needed. In this exercise, the intersection of the HUC12 and fire perimeter layers will be used.

5.   View the scale of the project area.

5.1.   In the Table of Contents, turn on the *HUC12_utm11* and *fire_perim* layers. Turn all other layers off. Drag the *fire_perim* layer above the *HUC12_utm11* layer. Zoom to the *fire_perim* layer.

5.2.   Change the symbology of fire_perim so it is hollow.

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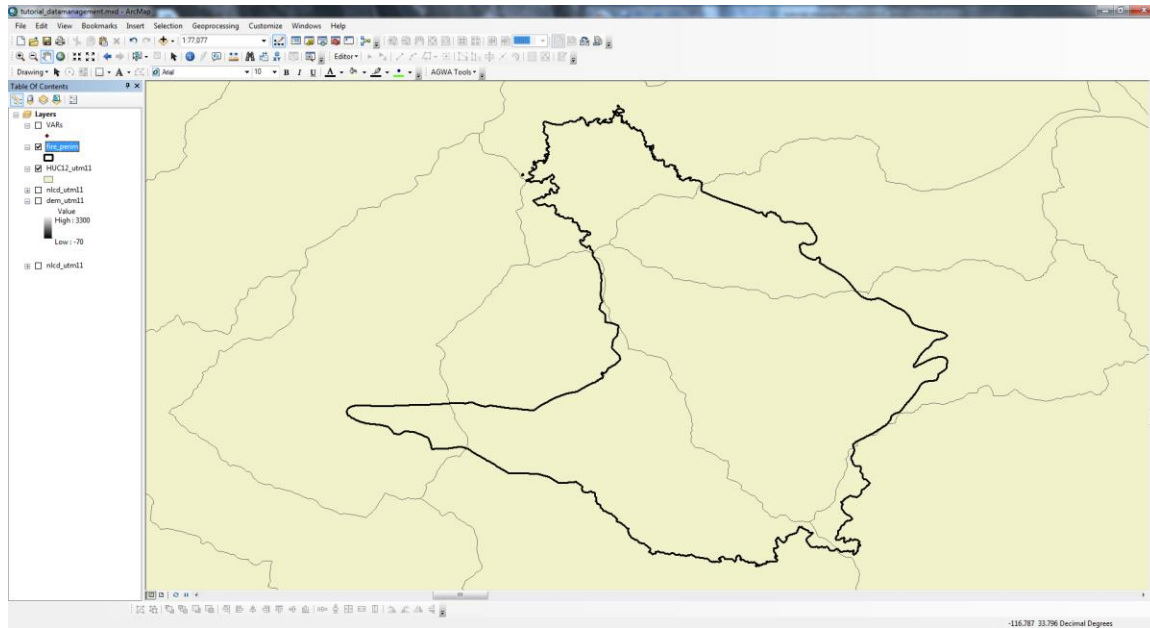
Notice that the fire perimeter crosses various watershed boundaries. Since the BAER team AGWA modeler may potentially have to model all these watersheds, the project area should include all the HUC12s that intersect the project area.

6. Select all the HUC12s that intersect with the fire perimeter.
   6.1. Under the *Selection* menu on the ArcMap menu bar, choose *Select by Location …*
       6.1.1. *Selection method*: select features from
       6.1.2. *Target layer(s)*: check **HUC12_utm11**
       6.1.3. *Source layer*: **fire_perim**
       6.1.4. *Spatial selection method for target layer feature(s)*: **intersect the source layer feature**
   6.2. Press *OK*.

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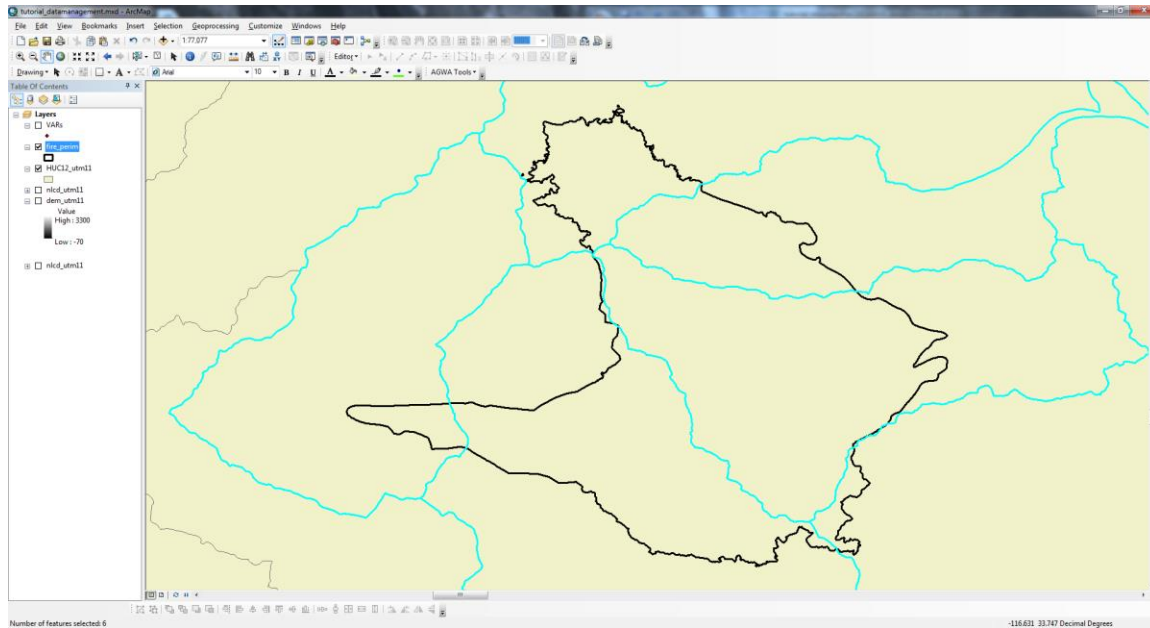
All the HUC12s that intersect with the fire perimeter are now selected.

6.3. Create a new shapefile of only the selected HUC12s.

6.3.1. Right-click on the **HUC12_utm11** layer, and select **Data > Export Data**
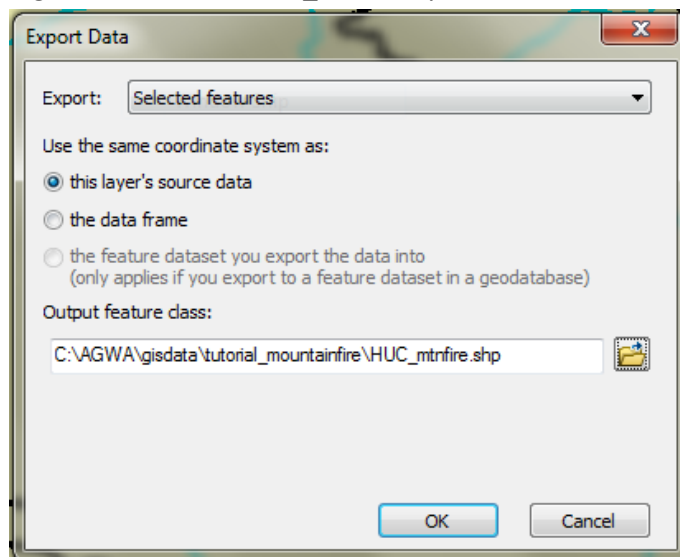
6.3.1.1. **Export**: Selected features

6.3.1.2. **Output Feature Class**: Click the **Browse** button.

6.3.1.2.1. Navigate to **C:\AGWA\gisdata\tutorial_MountainFire**.

6.3.1.2.2. Name the file **HUC_mtnfire.shp**.

6.3.1.2.3. Save as type: Shapefile

6.3.1.2.4. Press **Save**.

6.4. Press **OK**. This will create a new shapefile of only the selected HUC12s.

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6.5. Press **Yes** when the "Do you want to add the exported data to the map as a layer?" message appears.

6.6. Zoom to the new layer (**HUC_mtnfire**), and place the fire perimeter over it.
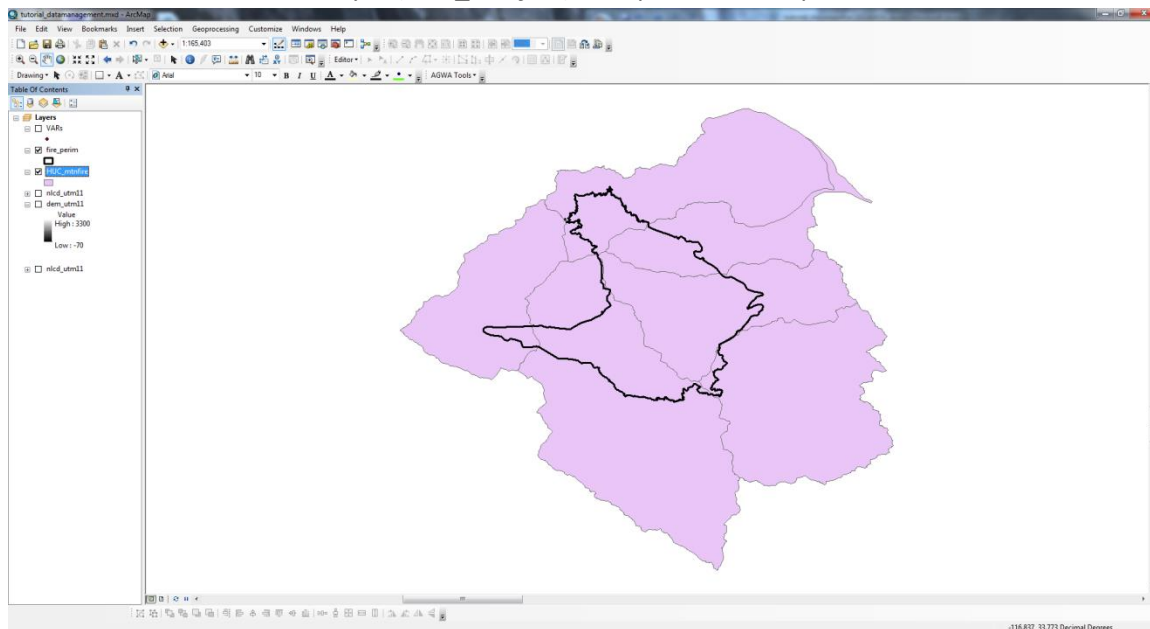
7. Merge all the polygons within the project area, and buffer the polygon.

   7.1. In the Table of Contents, click off the **fire_perim** layer.

   7.2. In the **Customize** menu of the ArcMap menu bar, select **Toolbars > Editor**. The Editor toolbar will appear.

      7.2.1. In the **Editor** dropdown menu, select **Start Editing**.

      7.2.2. In the **Start Editing** window, select **HUC_mtnfire**, and press **OK**.

         7.2.2.1. If the **Start Editing** window appears, with warnings about Spatial references click **Continue**.

      7.2.3. In the Tools toolbar in ArcMap, click the Select Features button [icon].

         7.2.3.1. Click and drag a rectangle around the entire **HUC_mtnfire** layer, so all the polygons are selected.

      7.2.4. In the Editor dropdown menu, select **Merge…** and press **OK**.

      7.2.5. In the Editor dropdown menu, select **Save Edits** then **Stop Editing**.
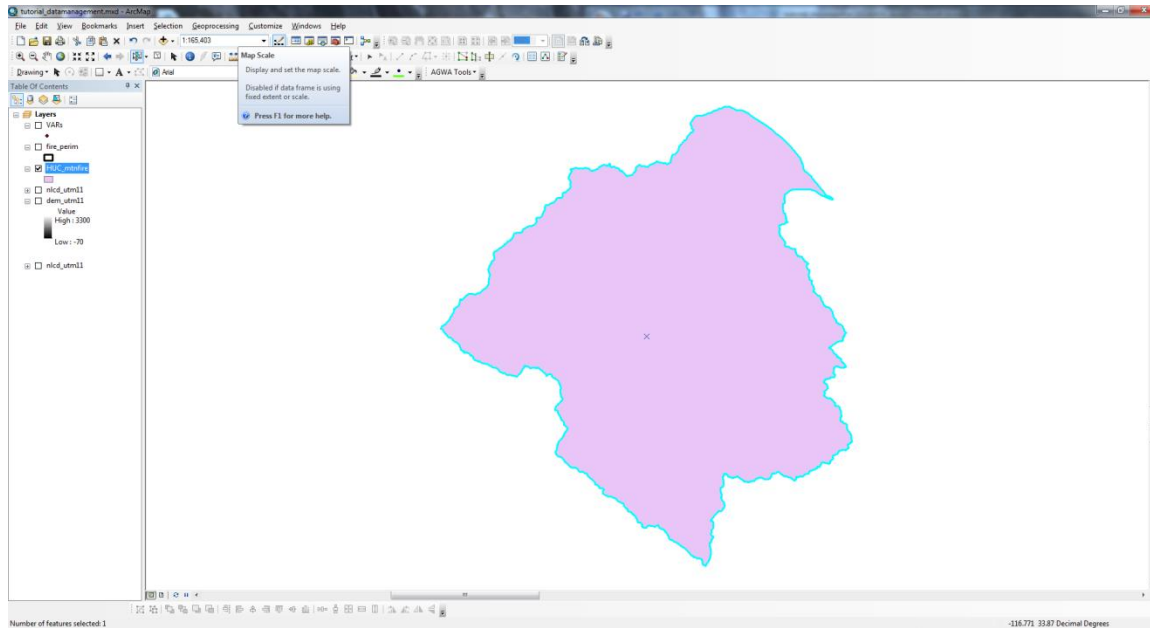
Now that a suitable project area has been made, it is always good practice to buffer the area in case the fire perimeter is updated or the DEM drainages do not match the HUC maps exactly.

7.3. Open ArcToolbox again.

7.3.1. Navigate to *Analysis Tools > Proximity*.
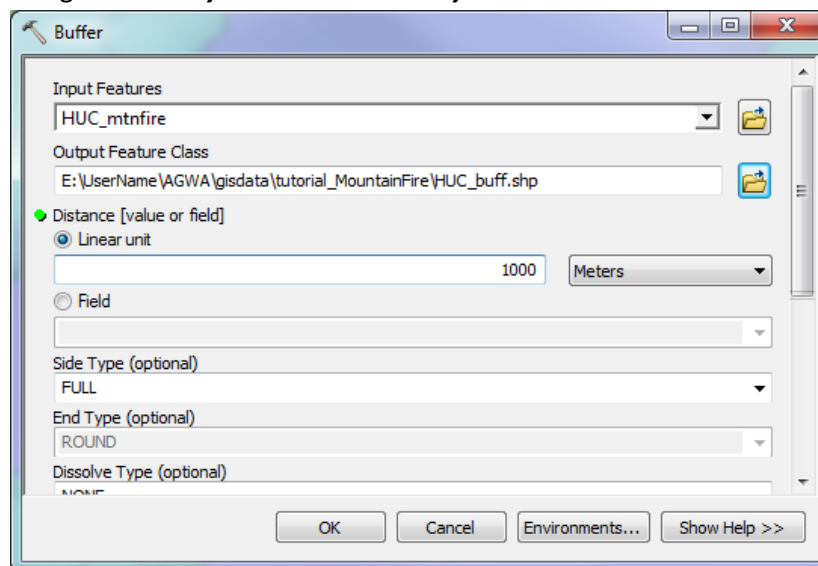
7.3.2. Double-click on the *Buffer* tool to open the tool.

7.3.2.1. *Input Features*: HUC_mtnfire

7.3.2.2. *Output Feature Class*: press the *Browse* button.

7.3.2.2.1. Navigate to C:\AGWA\gisdata\tutorial_MountainFire\.

7.3.2.2.2. Name the file HUC_buff.shp.

7.3.2.3. *Distance [value or field]*:

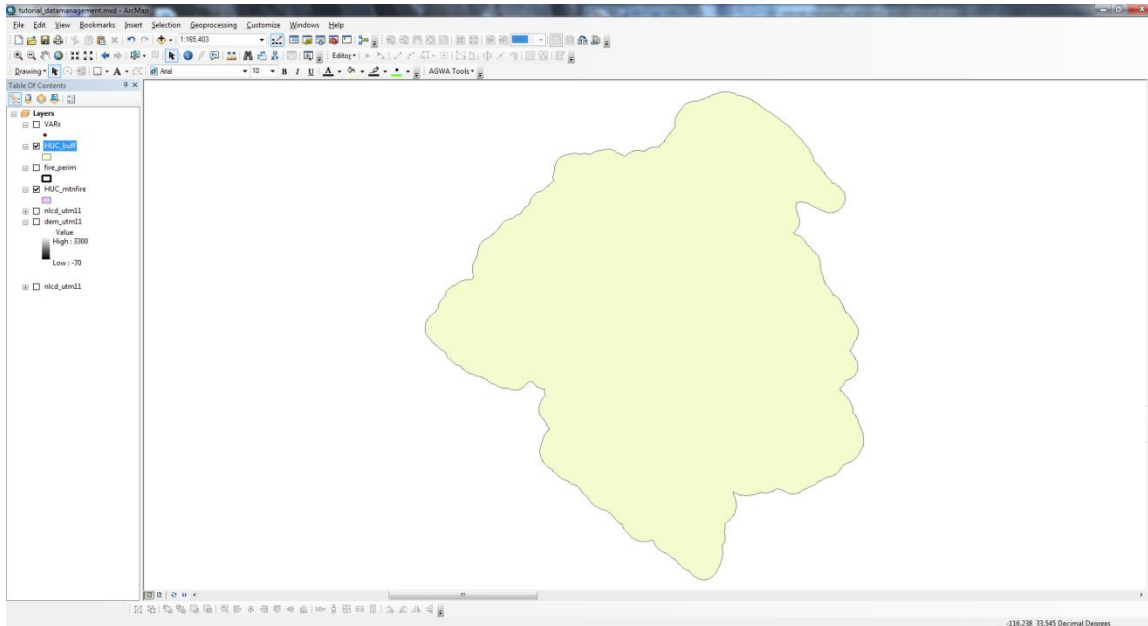7.3.2.3.1. Select the Linear unit radiobutton.

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7.3.2.3.2. Type **1000**.

7.3.2.3.3. Keep the units as **Meters**.

7.3.2.4. Leave all other fields as the defaults.

7.3.2.5. Press OK. Wait for the ***Buffer*** tool to run, which will create a new shapefile.

Step 2: Clip the Input GIS Layers to the Project Area Shapefile

Now that a suitable, buffered project area has been created, the large dem, land cover, and soils layers can be clipped to the project area.

8. Use the Clip tool to clip the shapefile layers to the project area.

    8.1. Open ArcToolbox again.

        8.1.1. Navigate to ***Analysis Tools > Extract***.
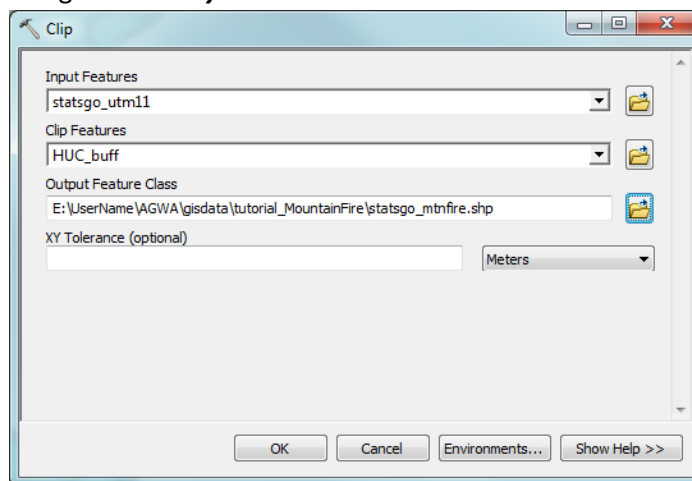
        8.1.2. Double-click on the ***Clip*** tool to open the tool.

            8.1.2.1. ***Input Features***: **statsgo_utm11**

            8.1.2.2. ***Clip Features***: **HUC_buff**

13

8.1.2.3. *Output Feature Class*: Press the *Browse* button.
    8.1.2.3.1. Navigate to **C:\AGWA\gisdata\tutorial_MountainFire**.
    8.1.2.3.2. Name the layer **statsgo_mtnfire**.
8.1.2.4. *XY Tolerance (optional)*: do nothing.
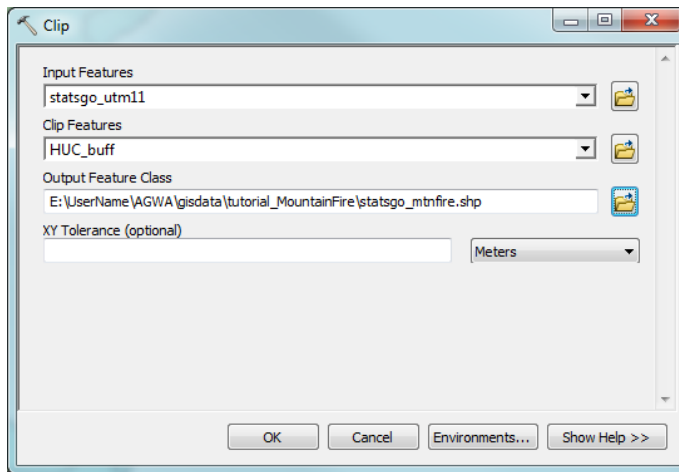
8.1.2.5. Click *OK*. Wait for the *Clip* tool to run, which will create a new soils shapefile.
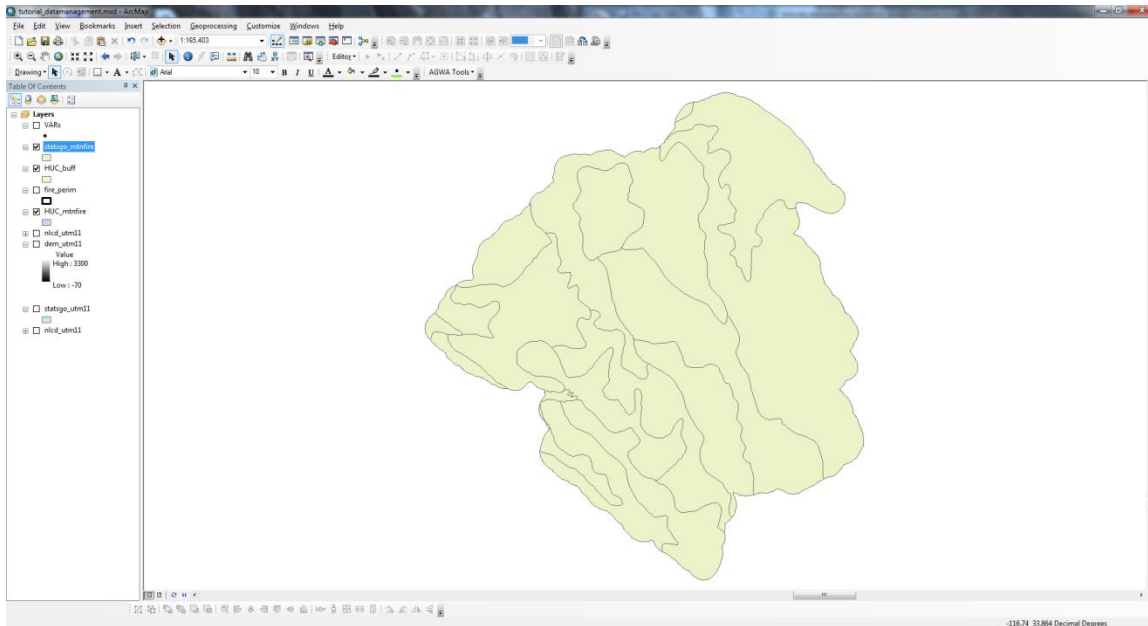
9. Use the raster Clip tool to clip the rasters to the project area.
    9.1. Open ArcToolbox again.
        9.1.1. Navigate to *Data Management Tools > Raster > Raster Processing*.
        9.1.2. Right-click on the *Clip* tool and select *Batch*.

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9.1.2.1. *Input Raster*: double-click and select **dem_utm11**.

9.1.2.2. *Rectangle*: do nothing.

9.1.2.3. *Output Raster Dataset*: Right-click and select *Browse*.

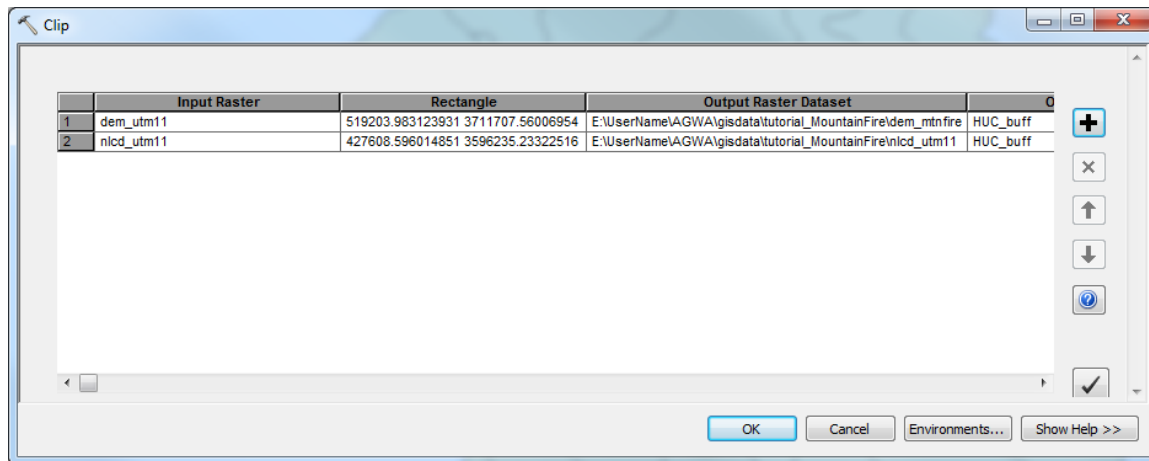   9.1.2.3.1. Navigate to **C:\AGWA\gisdata\tutorial_MountainFire**.

    9.1.2.3.2. Name the layer **dem_mtnfire**.

9.1.2.4. *Output Extent*: double-click and select **HUC_buff**.

9.1.2.5. *NoData Value*: do nothing

9.1.2.6. *Use Input Features for Clipping Geometry*: right-click and select Open

    9.1.2.6.1. Check the *Use Input Features for Clipping Geometry* box.

9.1.2.7. *Maintain Clipping Extent*: do nothing.

9.1.3. Click the Add row button ➕. Fill out the second row.

9.1.3.1. *Input Raster*: double-click and select **nlcd_utm11**.

9.1.3.2. *Rectangle*: do nothing.

9.1.3.3. *Output Feature Class*: Right-click and select *Browse*.

    9.1.3.3.1. Navigate to **C:\AGWA\gisdata\tutorial_MountainFire**.

    9.1.3.3.2. Name the layer **nlcd_mtnfire**.

9.1.3.4. *Output Extent*: double-click and select **HUC_buff**.

9.1.3.5. *NoData Value*: do nothing

9.1.3.6. *Use Input Features for Clipping Geometry*: right-click and select Open

    9.1.3.6.1. Check the *Use Input Features for Clipping Geometry* box.

9.1.3.7. *Maintain Clipping Extent*: do nothing.

9.1.4. Click OK. Wait for the *Clip* tool to run, which will create dem and land cover rasters.

15
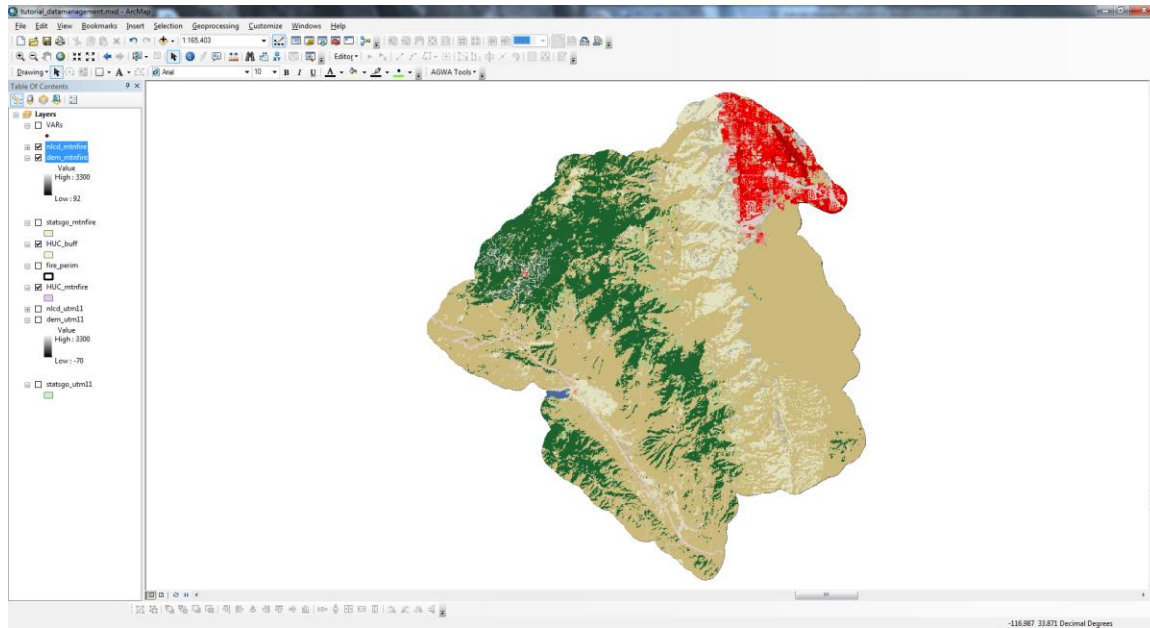
You are now finished working in ArcMap for this exercise, though you will use it and the data you prepared in the next exercise. The following step has already been completed because the computers you are using do not have Microsoft Access installed.

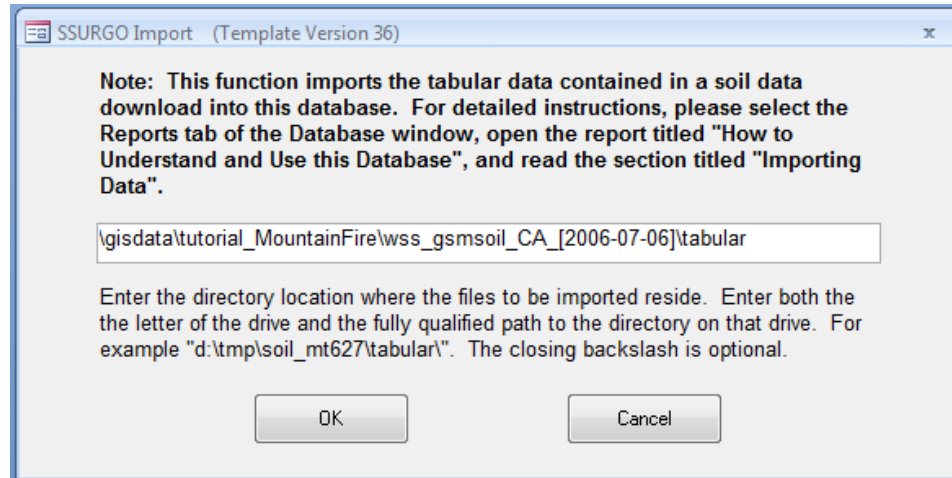<p style="text-align:center; color:red; font-weight:bold;">STOP HERE</p>

Part 3: Preparing the Soils Database

Although the GIS layers are ready for AGWA modeling, one final step is necessary. This involves importing the tabular soils data into to the SSURGO MS Access database. This is necessary for AGWA to access the correct soils information in the soils database.

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Step 1: Import Tabular Data into SSURGO Database

10. Open the MS Access database and import tabular data.

```
SSURGO Import    (Template Version 36)                              x

Note:  This function imports the tabular data contained in a soil data
download into this database.  For detailed instructions, please select the
Reports tab of the Database window, open the report titled "How to
Understand and Use this Database", and read the section titled "Importing
Data".

\gisdata\tutorial_MountainFire\wss_gsmsoil_CA_[2006-07-06]\tabular

Enter the directory location where the files to be imported reside.  Enter both the
the letter of the drive and the fully qualified path to the directory on that drive.  For
example "d:\tmp\soil_mt627\tabular\".  The closing backslash is optional.

          OK                    Cancel
```

10.1. In Windows Explorer, navigate to
   C:\AGWA\gisdata\tutorial_MountainFire\wss_gsmsoil_CA_[2006-07-06].

   10.1.1. Open *soildb_US_2003.mdb*.

      10.1.1.1. In the *Action Failed* window, select **Stop All Macros**.

      10.1.1.2. In the *Security Warning* banner at the top of the page, select Options...

         10.1.1.2.1. Select the *Enable this content* radiobutton, and click *OK*.

      10.1.1.3. The SSURGO Import window will appear. In Windows Explorer, open the *tabular* folder.

         10.1.1.3.1. Select and copy the file path for this folder:
   C:\AGWA\gisdata\tutorial_MountainFire\wss_gsmsoil_CA_[2006-07-06]\tabular.

      10.1.1.4. Paste the file path in the SSURGO Import window.

      10.1.1.5. Press *OK*. Wait for the database to import the data, then close the database.

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